ALGAE – A SOURCE OF INFORMATION ON CONTAMINATION OF SURFACE WATERS WITH HEAVY METALS

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Abstract: The aim of the study was active biomonitoring of pollution of the Janow water reservoir (Swietokrzyskie Province) with selected heavy metals: Mn, Fe, Ni, Cu, Zn, Cd and Pb. The water reservoir is fed by the waters of the Czarna Konecka river. Local water monitoring was carried out with the use of marine algae *Palmaria palmata*, which were exposed at 13 measurement points. After the exposure time, heavy metals in algae were determined by atomic absorption spectrometry (*F-AAS*). Determined *Relative Accumulation Factors* (*RAF*) for exposed algae samples indicate heterogeneous contamination of the reservoir waters with the examined analytes, especially cadmium. The results also indicate good accumulation properties of marine algae *Palmaria palmata* and their use in surface water biomonitoring.

Keywords: marine algae *Palmaria palmata,* biomonitoring, *Relative Accumulation Factors* (*RAF)*

THE USE OF AHP METHOD FOR SELECTION OF WASTEWATER TREATMENT SYSTEM IN AREAS OF DISPERSED SETTLEMENT

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According to the Central Statistical Office data, in 2018, the rural areas, constituting 93% of Poland's area, were inhabited by 15.3 million people, i.e. 39.5% of the country's population. About 70% of the population used the sewerage network, including 90% of the population from cities and only 40% of rural residents. The level of sewerage system development in the rural areas of Poland indicates the large negligence in this regard. The fundamental problem with building a sewerage system in rural areas is the necessity of constructing and operating numerous small wastewater treatment plants or constructing extended systems of collection and transportation that would supply wastewater to a collective treatment plant. Due to relatively small number of inhabitants they serve, the above-mentioned solutions are economically inefficient. Therefore, it is rational to use individual wastewater treatment systems.

In non-sewerage areas, the sewage collection in cesspits is the dominant solution. However, in many cases, the used cesspits are leaking, and the effluent collected in such systems are removed out of control and possibly end up in the soil or groundwater without purification required by law, which in turn poses a serious threat to the environment and health of local people. Household wastewater treatment plants are an alternative for individual systems for collecting and treating sewage.

There are many solutions available for household wastewater treatment plants differing in the technology used. The choice of the best option is a decision problem based on many criteria. Considering the unevenness of streams and pollutant loads in the inflow, wastewater treatment plants with an infiltration drainage system, sand filter, trickling filter and constructed wetlands are characterized by good resistance. Out of these, the system of infiltration drainage is the least expensive, but it is also the worst because of the threat to the aquatic environment. This solution also requires the largest built-up area. Additionally, sand filter treatment plants or constructed wetlands take up a lot of space. In the case of small plots, the best choice is a trickling filter or activated sludge treatment plant. However, the trickling filter systems are usually characterized by lower purification efficiency at variable flows, and those with sludge require frequent monitoring by a qualified worker. Due to the sensitivity to the changes in the sewage properties, activated sludge is not applicable to facilities with seasonal or uneven inflow.

The hierarchical problem analysis (AHP) method, also known as the Saaty method, is one of the best-known multi-criteria decision support methods in the world (Satty, 1972). Saaty proposed using this method in many areas to facilitate optimal choices when a decision maker has more criteria to evaluate different decision options (Satty, 1980). The advantages of the AHP method, such as flexibility, transparency and ease of use, objectivity of variant selection, the ability to compare both qualitative and quantitative factors, contribute to its high popularity and wide application, both in scientific research and solving decision problems (Satty, 2008), including environmental engineering (Hokkanen et al., 1997; Karimi et al., 2011; Mucha et al., 2015).

Four variants of household wastewater treatment plants were selected for multi-criteria comparative analysis: system with infiltration drainage, a trickling filter, activated sludge and a hydrophitic treatment plant. The proposed methodology allowed for an objective assessment and selection of the solutions of individual wastewater treatment system in the areas of dispersed settlement.

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